Dating young molybdenites and LLHR samples using Re-Os: The pitfalls and overcoming them

H.J. STEIN, R.J. MARKEY AND J.L. HANNAH

AIRIE Program, Department of Geosciences, Colorado State University, Fort Collins, CO 80523-1482 USA (hstein@cnr.colostate.edu)

The Re-Os chronometer is based on the decay of ^{187}Re to ^{187}Os with a half-life of 41.6 Ga. Since Re and Os are chalcophile-siderophile elements, most crustal rocks are characterized by relatively low ingrowth of radiogenic Os. One exception is the sulfide mineral molybdenite (MoS_2), in which Re substitutes for Mo, generally in the ppm range, and nearly all Os is the result of radiogenic ingrowth. Because of the remarkable resilience of molybdenite and its survival through high-grade metamorphism and ductile deformation, molybdenite dating now serves as a new and forefront tool to integrate tectonic, magmatic, metamorphic, and metasomatic processes with regional metallogenesis (Stein *et al*. 2001; Stein and Bingen 2002; Bingen and Stein 2003).

Young molybdenites and LLHR (low level, highly radiogenic) samples, which include low Re molybdenites or other sulfides with Os isotopic compositions dominated by ^{187}Os (Stein *et al*. 2000), present a special analytical challenge. The assumptions that common Os and blank corrections are insignificant are valid only for typical ppm level molybdenites. Workers spiking with natural Os explicitly ignore any common Os in molybdenite, but provide a means for fractionation correction to the Os isotopic measurement. At AIRIE, we have relied on a monoisotopic Os spike which permits a crude estimate of common Os, but does not permit a fractionation correction.

To meet the analytical challenge introduced by young molybdenites and LLHR samples we (1) use a double Os spike, (2) apply blank corrections (with uncertainties) that include good knowledge of the Os isotopic composition of the blank, and (3) consider the initial Os isotopic ratio for the age calculation. Relative to our single Os spike, the double Os spike permits a much improved estimate of the common Os and also allows a fractionation correction (Markey *et al*. in press). Young molybdenites and LLHR samples, which have markedly low abundances of radiogenic ^{187}Os, *require* monitoring of common Os. In this paper, we present examples for which Re-Os ages are highly dependent on common Os corrections and full consideration of the blank.

References

Bingen, B. and Stein, H. (2003) *Earth and Planetary Science Letters* **208**, 181-195.

Markey, R.J., Hannah, J.L., Morgan, J.W., and Stein, H.J. (in press) *Chemical Geology*.

Stein, H.J., Morgan, J.W., and Scherstén, A. (2000) *Economic Geology* **95**, 1657-1671.

Stein H.J., Markey R.J., Morgan J.W., Hannah J.L., and Scherstén A. (2001) *Terra Nova* **13**, 479-486.

Stein, H.J. and Bingen, B. (2002) *Geological Society, London, Special Publications* **204**, 319-335.

The Sahara — East Mediterranean dust connection revealed by strontium and uranium isotopes in Jerusalem speleothems

STEIN M.[1] AND FRUMKIN A.[2]

[1]Geological Survey of Israel, 30 Malkhe Yisrael St., 95501, Jerusalem, Israel. motis@vms.huji.ac.il

[2] Dept. of Geography, The Hebrew University of Jerusalem, 91905, Israel. msamos@mscc.huji.ac.il

Strontium and uranium isotopes in speleothems from Jerusalem, spanning the past 220 kyr, provide precisely dated record of long and short-term variation in dust flux from the Sahara to the East Mediterranean. Enhanced dust flux and Terra Rossa soil development during glacial periods is reflected by elevated $^{87}Sr/^{86}Sr$ ratios and high $[^{234}U/^{238}U]$ initial activity ratios in the speleothems (0.7082-6, and 1.07- 1.12 respectively). Lower $^{87}Sr/^{86}Sr$ values and low $[^{234}U/^{238}U]$ activity ratios (~0.7078 and ~1.0, respectively) reflect higher contribution of the local bedrock due to low dust flux and soil accumulation during most interglacial episodes. The strontium isotope system in the speleothem is a robust monitor of the Sahara monsoon-modulated climate, since dust uptake is related to development or reduction in vegetation cover of Sahara soil. Strontium and uranium concentrations and the selective removal of ^{234}U from the soil appear to reflect the regional climatic conditions that are modulated by the North Atlantic-Mediterranean climate system. Thus, the speleothem provides a combined record of the Monsoon- North Atlantic climatic system. The long-term stability in the glacial $^{87}Sr/^{86}Sr$ ratios (0.7083±1 over the past 220 kyr) suggests an overall similarity in eolian dust-sources, and uniformity in the synoptic conditions that dominate the dust storm tracks during glacial periods.